Why most Applicators don't work…. and what to do about it

Background

Whether you are an OEM, an ODM, or an EMS provider it is almost a certainty that you use labels and film adhesives. Computers, mobile phones, handheld electronic devices, medical diagnostics modules, and industrial devices of almost every shape and kind employ labels and film adhesive in numerous instances. The broad based acceptance of labeling and film adhesive show no sign of deteriorating, however, many organizations are left frustrated by the applicators chosen to automatically apply these very same components.

Problem

A recent case study listed the following common problems manufacturing professionals have with applicators:

- Setup is time consuming and complex
- Label or film adhesive does not peel consistently
- Equipment is complex
- Applicator is not accurate or repeatable
- Maintenance is difficult
- Service is poor
- Changeover time from roll to roll is too long
- Unreliable
- Lead time too long
- Design lacks flexibility
- Liner does not track consistently straight

Traditional Method

The traditional method most label and adhesive film applicators have been designed to use employs many old industrial solutions. In most cases these solutions while attempting to address problems end users experience are in fact creating a hidden burden and actually silently passing costs in the form of increased downtime, scrap, and additional labor to keep the label equipment operational. All factors that are easily disguised and kept underground from bottom line oriented management.

Industrial PLC's (for control) – PLC's are a long established workhorse method to control industrial machinery. There has been surprisingly little evolution in the PLC domain for many years. The simple architecture of single-task low-level programming language, circular program execution, and no encapsulation of data makes the creation of control programs difficult if not impossible for today's complex demands. Parameters that are programmed per application create flexible machines but are not handled well in a PLC environment. Thus, the universality of the applicator is severely hindered. In addition, while simple basic control can be implemented with a PLC, it is difficult to integrate automated procedures, error recovery, and visualization functions as an incorporated part of the application.

Ladder Logic – There is nothing inherently wrong with ladder logic. A primary drawback is in the inability of the programming language to easily implement programmable parameters.

Without full parameter integration the user friendliness of the system decreases. As the intelligence of the system decreases, expertise required by the operator increases. Ladder logic works okay for discrete logic, but math functions just don't fit the language without very complex adaptations. These same math functions are the enablers that provide for user friendly functions that limit required human expertise.

Rollers (to advance the liner) – The most common method to advance a liner is through the use of a roller to drive or take up the material. The well kept secret most rollers are hiding is that they actually encourage a liner to drift. The material of construction for the roller, the liner, the gear driving the liner, ball bearing and any other physical component in the system have a tolerance. The tolerances ultimately mean that the force across the face of the roller will not be consistent. This is true for the very first cycle of the labeling equipment; it only gets worse with wear and contamination that will always accompany industrial machinery usage. Beyond just a tracking issue adhesive contamination causes routine maintenance and periodic roller cleaning. Ultimately the rollers wear out and must be replaced and the process begins anew. All the while the poor operator is tweaking the applicators adjustments in a futile attempt to get the material to track straight.

Rollers also require that rotary motion be translated into linear distances. Various techniques can accomplish this task somewhat effectively but they cannot account for liner slippage and stretching. Slippage presents a particularly difficult challenge as the amount of slippage is constantly changing depending on a myriad of uncontrolled factors like release agent build up, roller durometer changes during component life, contamination, and wear.

Unitension – Using the take up roll on the machine for liner tension determination presents a fundamental problem. This method burdens the operator with constantly changing liner tension at the point of peeling as the roll shrinks. Thus an application may run well at the beginning of the roll but not through the entire roll of parts, leaving the operator to wonder why and begin adjusting the labeling equipment. Actually the intuition of the operator is right and something does need to be changed for the roll to run consistently. However, as we all know once the subtle tweaking of the label applicator begins it will usually take a trained technician to get the equipment back to a baseline operational state.

Applicators also employ peel assist methodologies like air jets or pre-peeling techniques to ensure the part peels. In the end without the capability to independently control the tension throughout the entire system these are only attacking the symptoms instead of curing the disease.

Speed – As today's technologies continue to force subassemblies and components smaller, accuracy of label and film adhesive placement has become increasingly important. Most applicator technology employed today was designed in a different era in which speed was the driving factor and accuracy was an after thought. Thinking of accuracy simply as a by product of the design can no longer be deemed acceptable in today's manufacturing environment.

Customize - In many instances custom machines are developed around the specific requirements of a particular assembly job. Although certain custom machines will perform the desired requirement successfully, many machines do not and throw into question the viability of applicators. Custom equipment is manufactured on a limited timeline and pushed into production to meet the anticipated launch date and volume requirements of the end product. Manufacturing locations are then saddled with the burden of ensuring that the equipment is kept operational and yielding required volumes regardless of its actual suitability. Adding to the complexity, manufacturing sites are increasingly located in low-tech regions with limited technical capabilities.

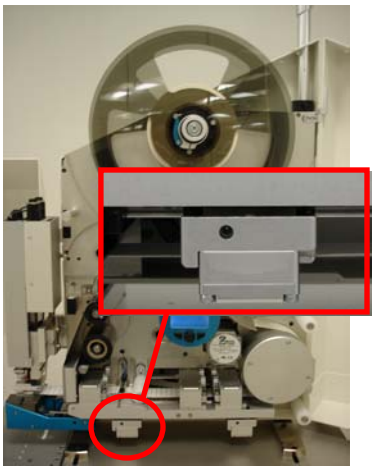
The Evolved System

Having examined the traditional method of approaching adhesive film and label applicator solutions and their inherent problems, let's take a look at a superior way; an "Evolved System". This system looks at the holistic view of the process and provides a clear outlook for success.

Multiprocessor – Use of a multiprocessor allows a system to be multi-tasking and provides the framework for implementation of sophisticated motion control. Data can be continuously collected at extremely high rates from inputs, interpreted and used to control the positioning or tension devices within the system. Parameters can be utilized and changed "on the fly" during the course of machine operation. As well as easier configuration, the multi processor offers reduced programming time, greater flexibility, and superior multi-tasking functionality.

Operating System - By utilizing an operating system all aspects of a higher complexity automated solution can be seamlessly integrated and programmed directly. Internet Browser pages can be utilized to setup the program and changes can be downloaded in real time over area networks. As well, recipes or programs for differing applications can be stored and loaded at the touch of a button. The control functions, subsystem process automation, error recovery functions, visualization tools, database integration, statistics, and many other parts can be included as a part of the standard product offering. Modern systems of this type can imitate the behavior of the human operator under certain conditions and react "intelligently"; optimizing performance and keeping human intervention to an absolute minimum

Clamping (to advance the transport liner) - Using clamps to feed rolls of material is not new and has been used for years in stamping machines for feeding rolls of sheet metal. This technique applied to an adhesive liner is effective by allowing for the material to simply be fed forward a linear distance. Working in conjunction with the data acquisition capabilities of the microprocessor the correct distance is constantly being measured and updated to ensure accuracy.



Clamping actively works to prevent two of the three largest sources for error in accurately placing labels and film adhesive; these are liner stretching and liner slippage. Clamps allow for superior control of the tension throughout the applicator as we

will learn in the next point limiting stretch. Slippage is minimized as clamps offer the opportunity for extremely high forces to be placed over larger surface areas. The wear on a clamp is so superior to that of a roller that it is not even a recommended spare part.

Tension Control – What is the most important part to be placed on an entire roll of film adhesives or labels? Don't just skip over this; think about the answer for a second. The answer is – the very next one. In order to reliably place the next one; the applicator must consistently have the right tension, at the right place, at the right time. From the moment the roll of adhesive components is loaded onto the supply reel controlling tension becomes critical. Tension controls at the supply reel, during feeding, in the peel zone and during rewinding of the scrap liner all play a critical factor in applicator repeatability. Supply reel tension is controlled by a resistance clutch which acts to limit the rate at which the material dispenses from the roll.

Tension in the peeling zone is set and controlled by an independent subsystem ensuring that each part presented to peel is actually under the identical tension as any other part on the roll. Tension at the peel edge is critical since this is the area where the highest forces are created and the adhesive component is actually peeled. Relieving these forces via tension relaxation during feeding eliminates liner stretch and unnecessary wear on the peel edge during feeding.

Accuracy - Today's technologies simply demand accuracy and repeatability. The continual push to add more features and capabilities into consumer products has converged to demand tighter assembly tolerances. Conceptual designs for applicators must begin with accuracy in mind. This necessity mandates design in ways that provide for tight tolerances to be held on all the manufactured components that make up the equipment. The principle of operation must be one that ensures accuracy with a speed to assure automation feasibility.

The three largest sources of inaccuracy are 1) liner slippage 2) liner stretch and 3) sensor repeatability. Liner slippage is addressed by clamps enabling higher forces than rollers. Stretch is minimized by inclusive tension control. Sensor repeatability is dealt with by empowering software to calculate optimal sensor settings and thus limit the required operator adjustment and subsequent expertise.

Standardize - Standardized applicators have established operational criteria and predictable quality. Standardized labeling equipment is also refined and enhanced through years of development with a process that allows for continuous improvement. Technical support and maintenance are simplified by including an ever increasing amount of functionality into software. High failure items are quickly identified resulting in decreased downtime. The reusability factor of standardized label equipment exceeds 95% while the reusability of customized solutions cannot be forecasted.

Conclusion

The purpose of this paper was to provide knowledge around why industrial labeling applicators fail. This presents a unique problem for those of you still reading. Now you possess an understanding of "The Evolved System". No longer will you be able accept label equipment with inherent flaws that only does the minimum that is expected. Because with awareness comes responsibility - to yourself and to others in your respective organizations.

You are now aware.

Applicators
Traditional vs. Evolved

Traditional Method	Evolved System
PLC	Multiprocessor
Ladder Logic	Operating System
Rollers	Clamps
Unitension	Tension Control
Speed	Accuracy
Customize	Standardize

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